ENGINEER-TRAINING WITH SYSTEM-ASPECT FOR THE FUTURE THE SYSTEM-ASPECT AND THE EQF ARE IN THE CENTRE

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1. INTRODUCTION

People, laics and professionals are taken by several effects in the globalization word. What can the social sciences do for the engineer-education, and how can these sciences help in the using of the skill? Who is the engineer, and what are its exercises? What can they do now, and what will able to do tomorrow, and what kind of social- (organism) background do they live?

The proxemic, the environment–ergonomic, the environment-sociology, the technical-sociology, and the technical-pedagogy are looking for the answers to these questions. The integrated aspect of these sciences can be the basic of a modern engineer-pedagogy.

In the centre of our presentation stands the 'European Qualifications Framework, which is a base to adapt into the National Qualifications frameworks. That is the task of the future.

2. MAIN TEXT

2.1. Summary of the reform of Hungarian higher education

The present status of the Hungarian higher education has the next parameters:

- It is undergoing a transformation; the two-cycle (tree, with the PhD-qualification) education has been taking over from the undivided and the parallel collegiate and academic qualification since 2006 September 1.
- The integration of the higher education has been finished for some years, wherein 30 State Universities and Colleges, and 47 ecclesiastic, and 33 Non State Universities and Colleges have been come off.
- ECTS has been used since 2002.
- The students' rate in the higher education is 38% in the given class, which is higher than in the other countries (for example: this number is 18% in Austria).
- The Board of Education has enforced the Bologna procedure, the enactments and the elaborations of the qualification-requirements have been running before the other countries. Many indiscretions and failures have been resulted.

  The complete register of the higher education is not fit into the registers of the intermediate professional education (OKJ), and into the national standards (ISCED, ISCO, etc.)
- The developed system, which has been made till now, has been evolved as follows:
  - In the first period there are 124 BSc/BA basic-consulting in all in 14 specialties, in 49 qualification sectors. There are 21 basic-consulting in the 8 qualification sectors of the technical qualification specialty. We have got the actuation license of many departments in the technical engineer-, art-,

economic-, and teacher- specialty in our university, and the education is starting from September.
- In the second period are there 210 Master/MSc consulting + 46 general-, professional-, and art teacher consulting, which are based on the BSc/BA basic-consulting in the divided qualification system. The MSc qualification can be started at latest from 2007.
- Doctor-, jurist-, art- and architect-qualifications has staid in undivided form.

2.2 Importance and merits of the system-aspect

Among such engineer-pedagogical circle it is needless to go in details why system-aspect or its decisive subcategories are important as we widely use the results of sciences, organizational and conducting sciences, cybernetics and consulting technologies. Teaching high technology cannot be imagined without the well known and applied computer planning and producing systems (CAD- CAM, CAQ etc.) Regulating circuits, intelligent robots, and other numerous technical principles, equipments and processes that apply the principle of feedback are widely known and of evidence nowadays. They moved into social sciences much later, which delayed for example the philosophical, sociological and economical responses for the environmental problems. Nowadays engineering practise demands the application of social sciences and practises due to the global challenge. Primarily human and social sciences and their sub-sciences play role in solving environmental problems, and in the functioning of informational and educational societies. The so called inter- or multidisciplinary approaches are especially important in drawing up and solving problems.
In this system of approaches, holistic aspect, virtuality and visuality shot the cybernetic based part-whole-environment relations.

2.3. Varying role of engineers

2.3.1, The engineer, its practise

In Hungarian language the word engineer (mérnök) derives from the verb- to measure (mérni). In the 17th-18th centuries those were called engineers who dealt with measuring in connection with military strongholds. In the following decades and centuries their works were rather in connection with regulation of rivers, building channels and dams and draining moors. Nowadays engineering practises developed during the Industrial Revolution. In this industrional epoch 3 main branches of nowadays engineering function developed:
- Planning, designing and developing new products
- Organizing, preparing, supervising and up keeping production processes
- Preparing for decision, management

In the so called post-industrial era flexible production and system of networks involved communication technologies, flexible production-service system developments and actuation (combining mass industry and manufactures) and handling environmental problems into engineering practises. It could be useful to deal with the latter and its social-technical projection as well.
On this forum special attention is needed to review and teach the new technology and to train and prepare the technicians and employers who are on different levels. In educational societies those engineers and engineer teachers who work for schools, companies or education enterprises have special role in the sociological process of technology and technique.
Eventually we may divide engineering practise into two:
A, Practises in the innovation processes:
- Technological- economical planning, analysis, coordination, research, development, experimental work

B, Operative practises:

- Technological conduction, prepare production, conduct production, preparation, supply technological information

2.3.2, Social environment of an engineer, role of social sciences

First of all I would like to add that an engineer may work in his everyday job in various systemic functions, so it is a need for them to learn the system itself. To learn the organizational know-how, which belongs to the social organizational sciences, want other techniques than the technological sciences want. Theory of organization is part of other sub-sciences as well, like theory of organization, science of organization, theory of decision-making, psychology of organization etc., so it means a demand for knowing the social sciences integratedly by the engineers and students of engineering. Without any given empirical data we might say that theses sciences are not involved widely into the engineer-training programs/modules. It is a fact that economical sciences have a privilege on human and social sciences.

Without going in details into organizational sociology we have to mention that the social environment of engineers do not only narrow into various types of organizations but hit their social relations and several aspects of social appreciation as well.

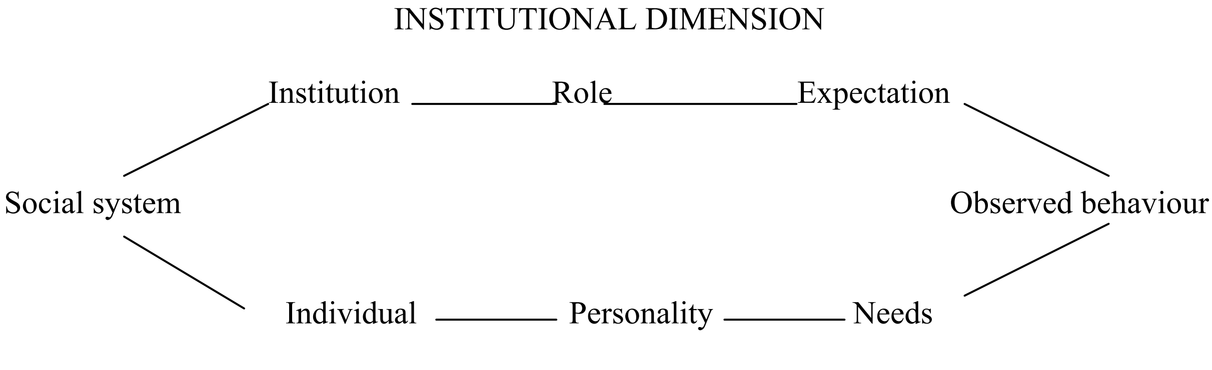
2 basic forms of organization are important for the engineers. Certainly there are countries where industrial and administrative (strategic/governing) engineer training are divided on gradual level not only on postgradual one.

One is plant/company/factory/firm etc. These case sociological characteristics are given by the hierarchy of the company and the formal and informal relations. Mostly bureaucracy and hierarchy are dominant in plants, but the so called ‘quality circles’ (Z-type organizations) use bottom-up communication and decision making.(vide success of Japan)

How can we replace hierarchy? The answer has been given since the 70s’: with new network models, which can be seen as groups of talking and information, resource and conception changing people. Apart from the sociological definition we also know pure technical networks like power supply systems (gas, electricity) Pieces of information can be gained and and transferred easier in networks and the system links well.

2.3.3, Roles of the engineer

Roles mediate the expectations of the society and culture towards the individual. These way roles mean a link between man and society or its certain groups. Individual and organizational dimensions may be drawn up in a pattern like this:



1. Graphic: Institutional and personal dimensions of the role

Using this pattern may make it easier to explain the behaviour of engineers as professional in different roles and functions. To the laics an engineer is a professional. Being a professional is fetished because the individual try to compensate its lack, derived from its own lost experience, with placing confidence in the professional. A new question in connection with roles: what makes a professional to change its mind about a thing? Let's think about environmental problems when professionals change their mind moment by moment. This is another dimension in human behaviour that we call moral factor, which involves interest that influence attitude. Social conflicts are shot by differences in interests. Engineers should be trained to solve them. Various role plays, drama pedagogy offers socio-technical elements, they need to be involved into engineer training. Fortunately we can find good examples also in Hungary not only abroad. I have seen so good examples in Germany in Hamburg, Freiburg and Karlsruhe.

I have worked out the theoretical and practical details of a role learning method which considers what an engineer should answer the laics, other professionals or same professionals for the same question. What should be the curriculum of the communication training about making contact with a client? How to be able to sell a product, plan, service, his own knowledge while staying correct, ethical prospect? These questions are no more in only connection with theoretical trends and theorems of social sciences but with curriculum design of engineer training as well. This means educational/pedagogical issue, too. Developing social-communicational skills are prised in engineer training. To know which ideas, sciences are needed cannot be given universally. Although there are examples, places to give a standard. This idea drives to the next chapter.

2.4, European Qualifications Framework

Why do we need the European Qualification Framework?

The necessity for all life learning has grown in such Europe which is characterized by quick social, technological and economical changes. Due to the ageing of the population those challenges sharpen which intensifies the needs of refreshing and renewing knowledge, skills and widely seen competencies. All life learning is complicated by the lack of communication and cooperation among educational and vocational institute of different levels. Bounds among institutes and countries set back not only the access to education and training but the effective adaptation of acquired knowledge and competencies, too. This problem roots primarily in the lack of transparency among qualifications and in being unwilling to accept foreign qualifications, which may be caused by the lack of arrangements that would make people possible to make use of their qualities abroad. The tendency that the knowledge which is gained in non-formal or informal institutes, like work places, is not accepted as equivalent with the one that is gained in formal primary education or training- is included in the above problems. These problems and challenges must be dealt in EQF.

Definition of competence

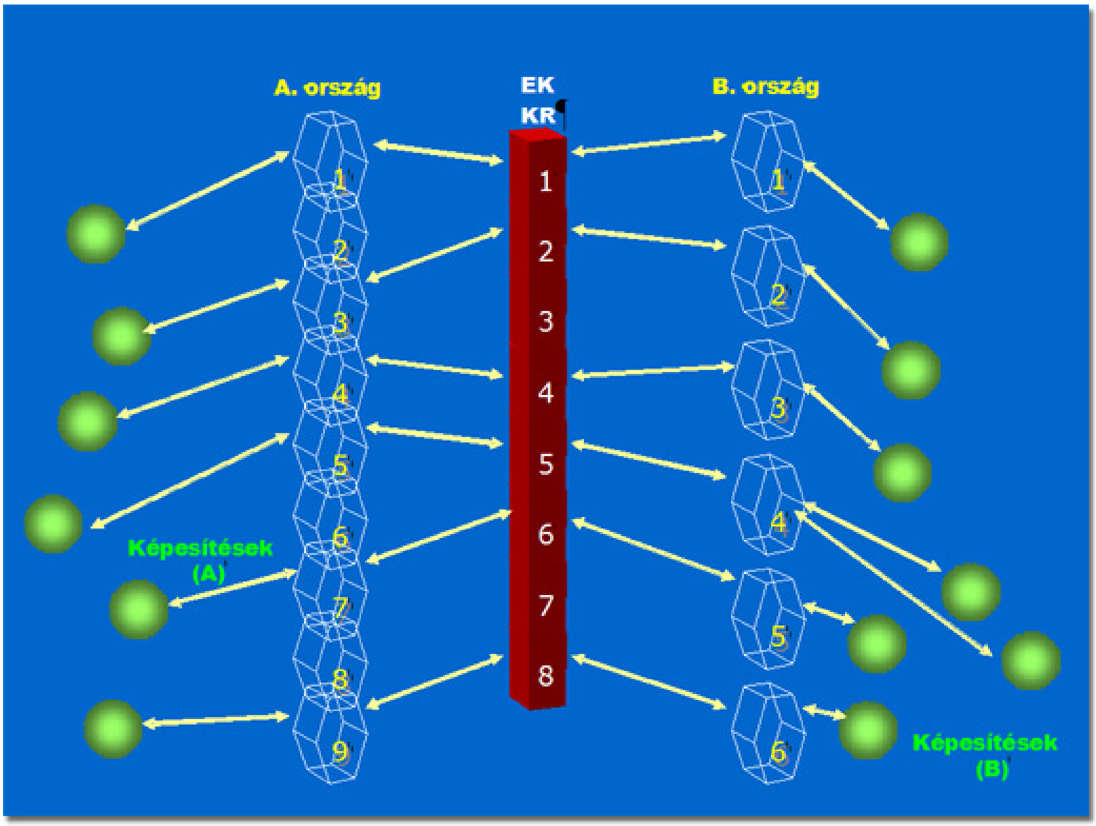
Applying French, British, German and American literature the definition of competence is the following:

Competence includes: *i) cognitive competence that covers the application of theory, definition and passive knowledge gained by experience; ii) functional competence(skills or know-how)that is needed for a concrete (occupational, educational or social)practise; iii)personal competence that includes the knowledge of perfect behaviour in certain; and iv)moral competence that includes personal and professional values*

This interpretation of competence reflected in the mentioned reference levels of EQF in this text which make a difference among knowledge, skills, and widely seen competences.

The eight levels

Researches of the credit transfer and accumulation systems of technical and vocational training ended in the conclusion that 8 levels are necessary to make out a European framework for tertiary, secondary and vocational education. This number is based on researches, work structures of companies and tertiary educational researches of Bologna process. The eight-level structure offers the best suitable solution to the national qualification structures. Bridging solutions are needed in the cases when there are few, easily understandable levels or there are more levels and more particular information about the levels. Since the CEDEFOP-report the 8-level structure has been accepted by several corps of qualificational systems including those who work in the field of technical and vocational training as well.



2. Graphic: Connecting model of EQF and countries' qualification levels

A proper description of all levels is needed in EQF which distinguishes the certain levels from each other. It is a complex process to prepare for the description as numerous ways of description are known. It is easier to the users if the definition of competence is used as a base in the description of the levels and EQF can become a real meta-framework that let the countries to compose their educational programs and qualification structures(including their content, realization and evaluation). Referring to the competencies and results of learning matches with the direction of tertiary education materials, like ECTS, furthermore it is a proper definition for technical and vocational qualifications.

2.5, Curriculum design and learning methods. Integration of teaching and learning methods.

First of all we mention teaching and learning methods and forms that are found in engineer training in most of the countries and faculties of engineering. Certainly there are different levels, measures, technical and personal backgrounds. What are they?

- traditional lectures and seminars,
- experimental learning based on laboratory measures,
- simulating and modelling processes,
- curriculum visualization as integrating research results into curriculum,
- learning with locale measuring, learning with locale,
- multimedia, interactive learning.

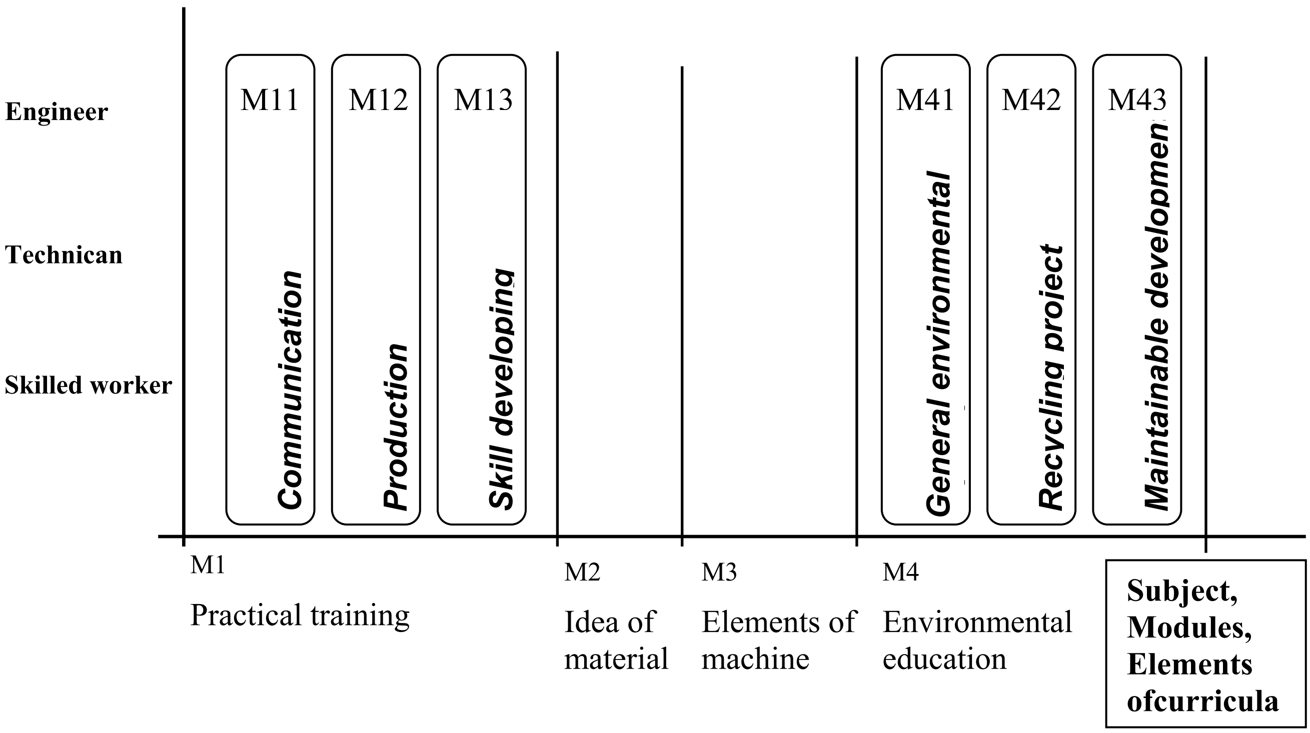
I emphasize curriculum visualization as the modern form of integrating research results into curriculum. It is primarily used in the USA to integrate the results of scientific and technical researches into secondary and tertiary curricula. This way a quick knowledge transfer can be gained as a team of researchers, teachers and media professionals makes the latest results visible and using research results are made quicker.

This is a part of curriculum design in the different levels of the school system. In my opinion traditional design of engineer training curricula can not be used longer. The rate of technical development is so quick that this traditional way of curriculum design cannot keep step with it.

Nowadays they only clasp one qualification level and one educational level. In case of engineer training it has a role in its social environment where he meets technicians, skilled workers so it is advantageous if they know each others professional role and knowledge. There is a need for a common knowledge and qualification in the fields of theories and practises (draft, material and production knowledge, measures etc.), which is equally important on each qualification levels. So it is practical to take this into account in engineer training curriculum design. I call this the aspect of vertical modularisation.

I show the point of the aspect of vertical modularisation in the following graphic:

Qualification levels



3. graphic: The vertical module system

3. Conclusion

What can we do together? Let's review, look at it and reflect!

Finally, so we are here. What can we do for the engineer education? Some recipes for the recent symposium: let's review the models and the respects of one other during the performances! Let's raise the collective parameters, reflect the critical points!

As follows I offer some respect for review of these:

3.1. Science and practice, technical sciences and engineer-pedagogy.

3.2. Do we teach principles or examples?

3.3. Relation and rate of theory and practice.

3.4. Comparing analysis is needed in the certain engineer and engineer teacher training systems of countries. Aspectual, methodological and legal frames should be worked out to accept and develop these qualifications mutually.

3.5. There is a need to find the common base of engineering competencies and the elements of the vertically built curriculum modules. Curricula, training and retraining program design should be synchronized on national and international levels.

3.6. Opportunity of a "common" engineer-pedagogy/professional methodology PhD-qualification with EU-applications (Tempus, Leonardo).

This conference is important in the forming of the European Higher Education Area. The cooperation in more projects is important in the engineer-education, and in the engineer-teacher-education.

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CURRICULUM VITAE

Name	**ISTVÁN, LÜKŐ DR. HABIL**
Occupation or position held	**ASSOCIATE PROFESSOR, DIRECTOR OF INSTITUT FOR TEACHER TRAINING**
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Research Topics	**curriculum development for vocational training and engineering education** **- vocational training structures and vocational qualifikations** **- environmental sociology,- environmental pedagogy**

Expert Comittes and Organisations:

Vice- Chairman:

- Regional Centre for Hungarian Academy of Sciences, Veszprém

Professional Comittee of Educational Sciences

President

- Regional Centre for Hungarian Academy of Sciences, Veszprém
- *Work Comittee of Environmental Pedagogy*

Member

- **of IGIP**
- **of ISA(International Sociological Association, Environmental Groups)**
- of National Vocational Training Association
- of Hungarian Sociological Association
- of National Pedagogical Society
- of Hungarian Environmental Education Society
- of National Society for Teacher Training

Publications: Total: 232